Energy+Environmental Economics

Renewable Futures in US and Mexico

CEC-Mexico Technical Workshop on Efficiency, Renewables and Grid Management

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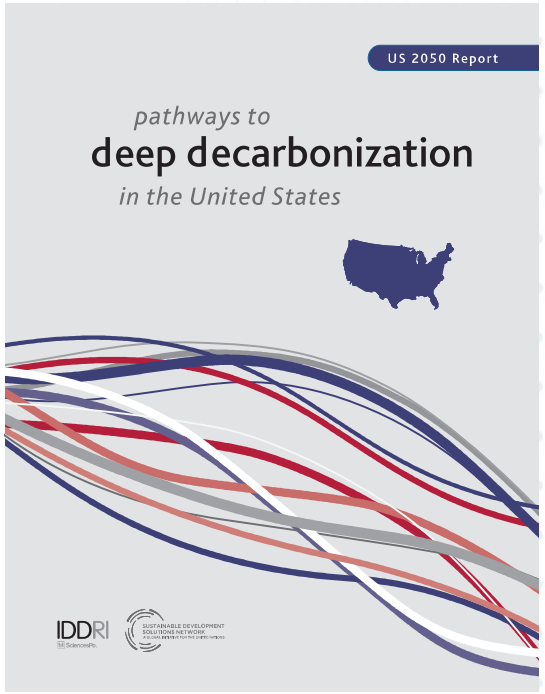
Energy + Environmental Economics (E3)

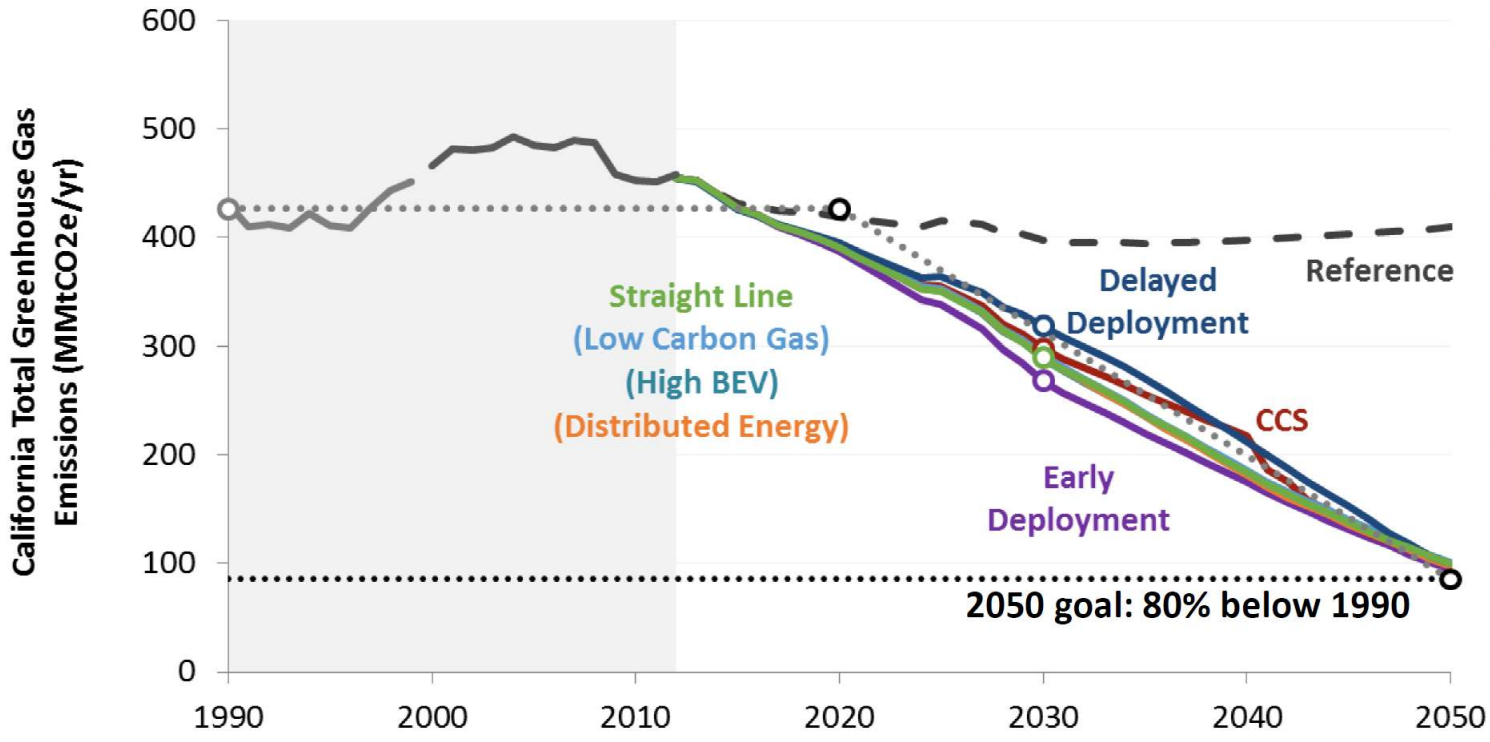
Renewable trajectories and long term system planning

- **E3 has actively been working on long term futures for California to meet the Governor's goal of reducing GHG 40% below 1990 by 2030**
  - PATHWAYS model reflects interaction of electric system with building stock, transportation, and industry
  - E3 also developed the United States DDPP analysis
- **Long term approaches to renewables planning emphasizes 2 questions:**
  - **Where are you headed next?**
  - **What is the impact on the larger energy system?**

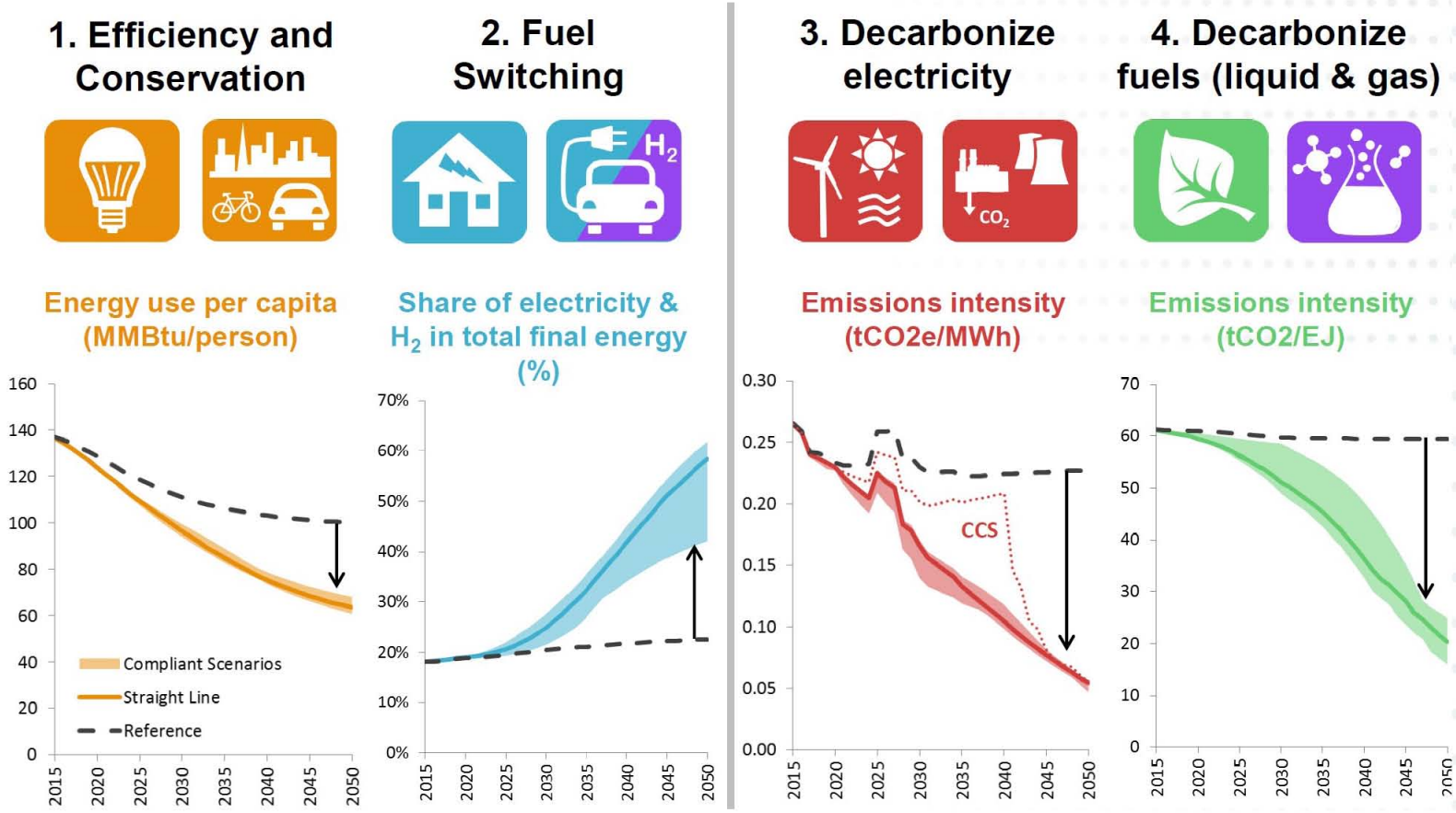


Multiple approaches toward 2030 produce trajectories consistent with a 2050 goal of 80% reductions

- **Includes separate pathways that emphasize DG and bulk system build**



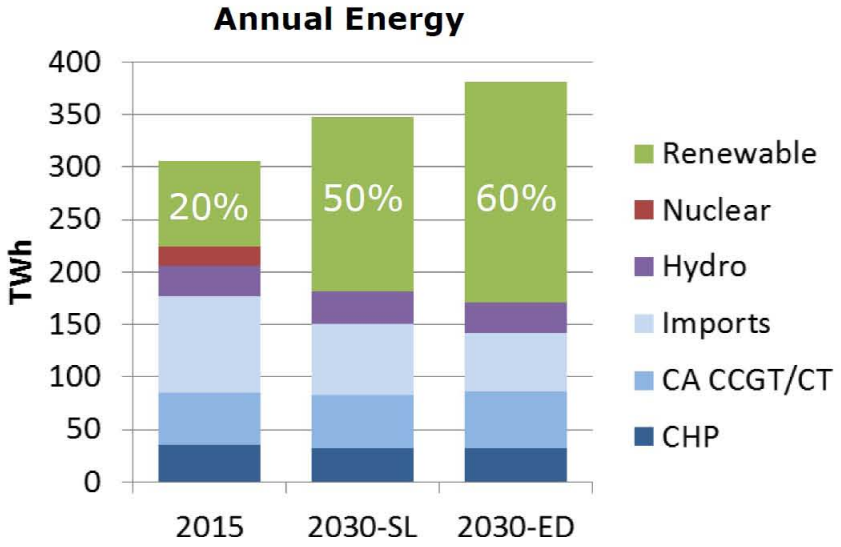
Decarbonizing CA's economy depends on four energy transitions

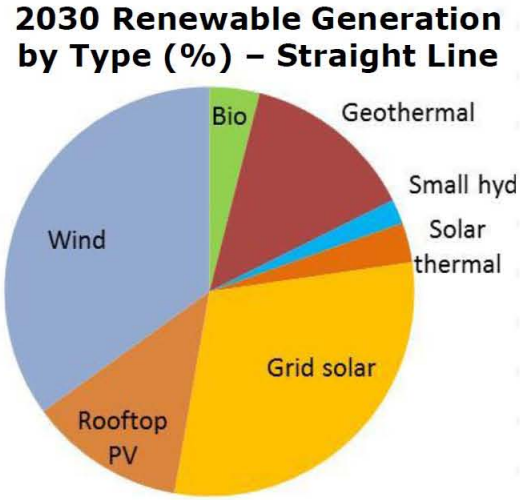


Renewables in California to account for 50-60% of annual electricity by 2030

+ **Average renewable additions are ~2,400 MW/year (plus rooftop PV) through 2030, mostly solar and wind resources.**

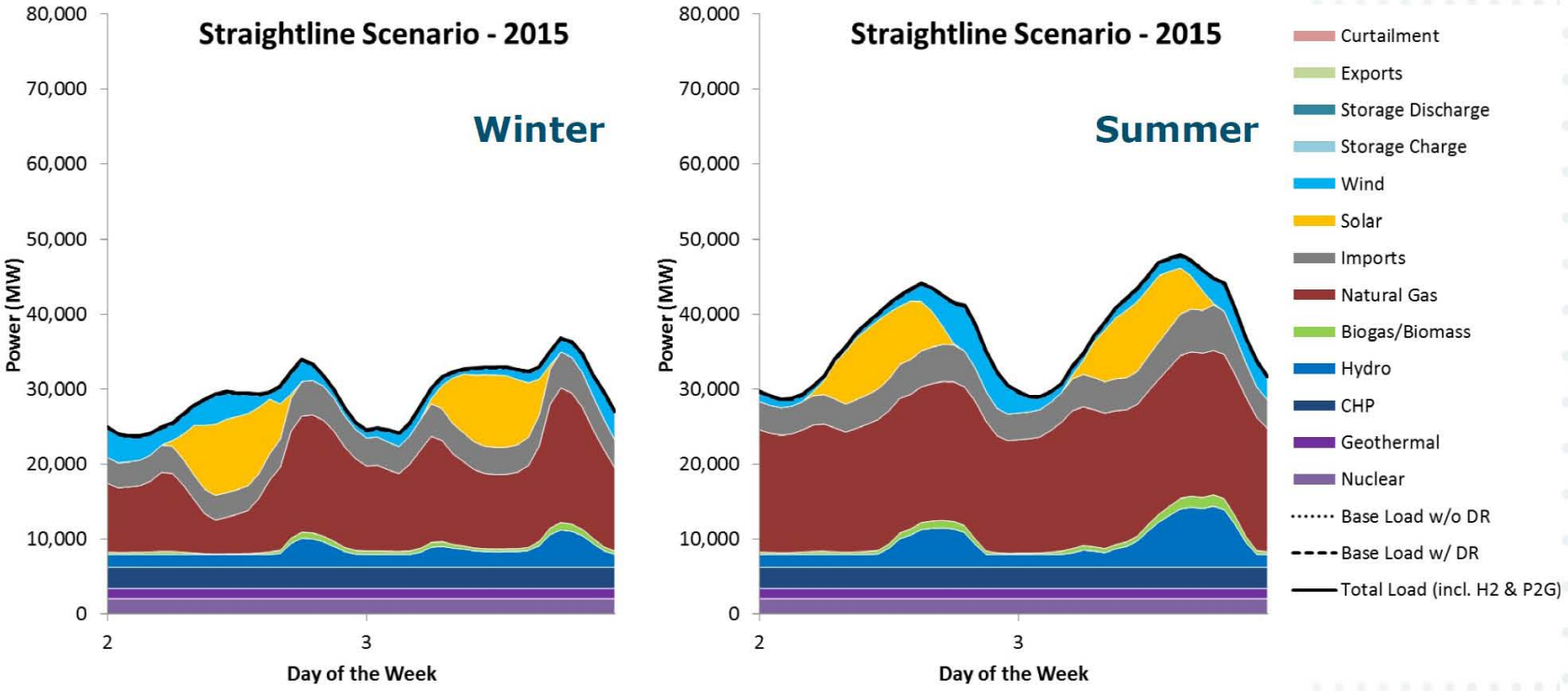
+ **Integration solutions are needed in all high renewables cases:**
  - regional coordination, renewable diversity, flexible loads, more flexible thermal fleet, curtailment energy storage, flexible fuel production for ZEVs





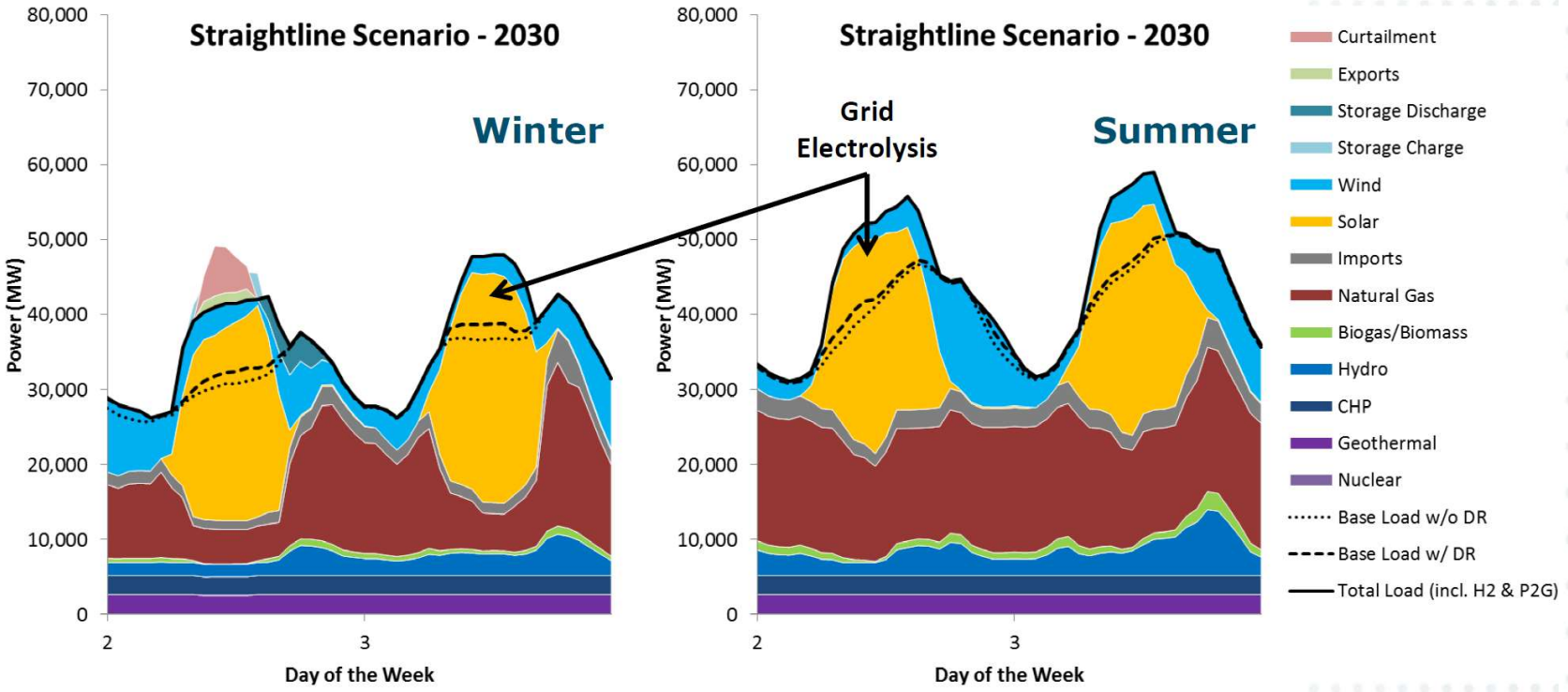
Electricity Balancing - 2015

+ **In near-term, renewables balanced largely by natural gas and hydro**



Electricity Balancing in 2030

- **By 2030 integration options also emphasize imports-exports through regional coordination, and flexible loads (including flexible fuel production through electrolysis)**



CA future market summary & lessons on distributed side

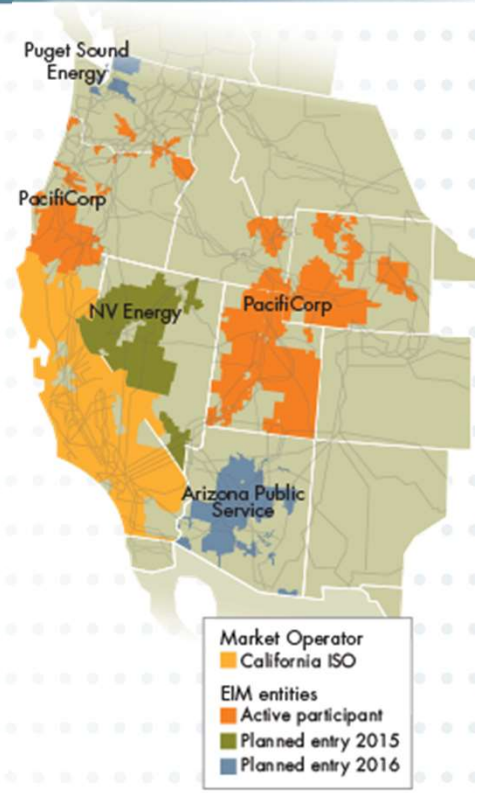
- **CA futures include huge deployment of renewables (distributed and bulk), and electrification**
  - Penetration distributed solar could exceed 15 GW by 2025 (from over 3 GW today)
  - Proposed RPS targets of 50% by 2030
- **Solar prices have fallen significantly for bulk system and for community solar**
- **Solar financing for customer systems has created a new industry and tremendous customer adoption**
- **Retail rate design influences customer adoption, making reforms challenging balance**

Long-term Integration Challenge

- **<u>At all levels</u>: Whether it is rooftop or bulk system solar**
  - We face a primary challenge of integration under high renewable penetration
  - For California, overgeneration conditions rise when renewable share exceeds 40% without more storage or coordination
  - Potential solutions include greater regional coordination (with AZ, NV, Northwest), storage, diverse portfolio, bi-directional DR
  - Long-term options: renewable fuel production (at bulk system)
- **<u>Distributed level</u>: other potential challenges**
  - Less visibility into customer side increases forecasting error
  - Possible less system control during contingency conditions
  - Distribution level constraints to reaching bulk system
  - Advanced planning can help these at low cost - but need to know if you are headed for for a high or low renewable system

Potential Common Areas to Work Together

- **Direct coordination of electric systems**
  - Energy Imbalance Market (EIM) & other system-to-system exchanges
  - Potential high value transmission
- **Energy storage**
  - Planning approaches for optimal use
  - How to value and incent
- **Coordination of market**
  - Larger markets drive down costs, benefiting all consumers



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Thank You!

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